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Potential of Direct Use of Geothermal Energy in Uganda

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ABSTRACT

The main geothermal energy prospects currently under investigations in Uganda include Kibiro, Panyimur, Buranga and Katwe. The results so far indicate reservoir temperatures up to 200°C capable of producing electricity and for several direct uses. The geothermal energy in Uganda can be used in drying and preservation of fish from Lake Edward, Lake George, Lake Albert Kazinga Channel, River Semuliki and surrounding swamps. Uganda being in the agricultural country, the geothermal energy can also be used in drying of cash crops like cereals, cotton, coffee, produce (maize, beans, cow peas, and ground nuts), cassava, palm oil, cocoa, tea and curing tea and tobacco commonly grown in the vicinity of the geothermal fields. Geothermal heat can be used to extract salt from the brines of the salt lakes in Katwe field (Lakes: Katwe, Munyanyenge, Nyamunuka, Bunyampaka, Omurumuri, Kitagata, Mahiga and Kikorongo) and brines produced from Kibiro saline soils. Geothermal heat may also be used in pasteurisation of milk especially for the cattle farmers in the Basongora communities (in the vicinity of Katwe), Batuku (who are close to Buranga) and Baraaro who live close to Kibiro and Panyimur prospects. The tourism like spas can be established in geothermal fields close to the National Parks like Katwe, Buranga and Panyimur. Green houses for commercial flower production is another potential area. Geothermal heat close to oil fields may also be used to heating crude petroleum pipelines in Kaiso-Tonya and Rhino Camp oil and gas fields while being transported to the Kabale oil refinery located on the shoulders of the Albertine Graben.

1. INTRODUCTION

Uganda has over twenty documented potential geothermal field areas, most of which are found in west Uganda. The potential geothermal areas are located in and around the western arm of the East Africa Rift System that runs along the border of Uganda and Democratic Republic of Congo. Other geothermal areas are associated the Aswa Shear Zone in northern Uganda while one hot spring is located on top of Mt. Elgon (Fig. 1). The Rift Valley is characterised by geothermal systems, salty and fresh water lakes.

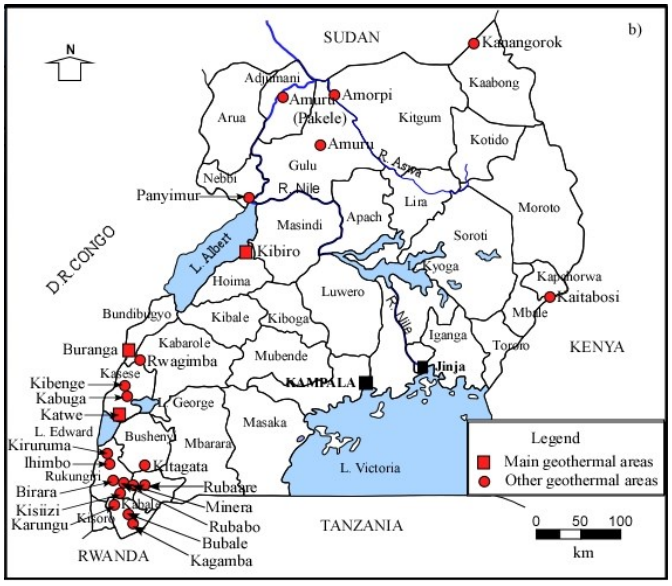

Figure 1: Locations of the geothermal field areas of Uganda (Bahati, 2005).

The exploration studies carried out so far in the four geothermal prospects of Kibiro (in Hoima district), Panyimur (in Pakwach district), Buranga (in Bundibugyo district) and Katwe (in Kasese district) indicate reservoir temperatures up to 200^0C (medium to high temperatures systems). Hence, these prospects have potential for electric power production.

2. ECONOMIC ACTIVITIES

Uganda has an area of approximately 240,000 sq. km. and a population of 25 Million (Population census, 2002) with an annual growth rate of 3.5%. Agriculture accounts for over 50% of the GDP. Over 85% of the population is rural and relies on subsistence agriculture for livelihood. An increasing proportion of the population practises commercial agriculture for in country consumption as well as for export. Among the main crops cultivated are: (a) Main cash crops; coffee, tea, sugarcane, tobacco, cotton, cocoa, and palm oil, (b) food crops; maize, wheat, millet, sorghum, cassava, potatoes, and rice, (c) the oil seed crops; ground nuts, coconuts, castor, sunflower, simsim, (d) horticultural crops; pineapples, mangoes, bananas, papaw, passion fruits, avocados, vegetables, onions,

tomatoes, carrots, and flowers, (e) livestock products; dairy products, beef, pork, poultry, skins and hides, and fish. In order that the farm produce reaches the consumers in an unspoilt state, they need processing and/or cold storage.

Geothermal energy could be used in fish and crop drying to enhance the efficiency of the drying process, and also in processes where wood fuel is being used such as tobacco curing, sugar processing, tea drying to substitute for the increasingly scarce wood fuel, and create possibilities for more valuable uses of the wood and protecting the environment. The manufacturing sector is growing very fast and both mineral and agricultural based products could benefit from better-planned utilisation of geothermal heat.

3. CURRENT UTILISATION

The Uganda geothermal project is still at the surface exploration stage with no geothermal wells drilled yet and therefore the current utilization is from the fluids discharges from hot springs which are used locally and has not been quantified. The geothermal water is being used as a source of salt at Kibiro and Katwe. At Kibiro the geothermal water is concentrated using dry soil by capillary attraction, the impregnated soil is then scooped and the salt recovered by dissolution and evaporation to dryness. At Katwe, the method is different from that one at Kibiro, and is done by channeling the brine into concentration ponds from which the salt solidifies on the surface by natural evaporation during the dry weather. Most of the Uganda hot spring waters are currently used for spas and are believed to have curative powers for skin diseases and rheumatics. The only known in-house use of geothermal energy is at Kisiizi hospital situated in Rukungiri district, SW-Uganda, where hot water at a temperature of 32°C is tapped from a hot spring and used in hospital for bathing and other domestic uses. The hot water is also used for watering animals as a substitute for salt licks because of its high salt content. And lastly, hot springs are a tourist attraction (Bahati, 2019).

4. PROPOSED DIRECT HEAT UTILISATION

The heat in the geothermal fluids from the power plants and direct from the wells may be used in various direct uses before they are re-injected as described in the next sections.

4.1. Drying and preservation of fish

The geothermal heat in Kibiro can be applied in drying of various types of fish caught from Lake Albert. Currently the local fishermen dry the fish in direct sunlight (Fig. 2). Geothermal heat from Katwe prospect can be used to dry fish from Lakes George, Edward and Kazinga Channel while in Buranga area geothermal heat may be used to dry and preserve fish caught in River Semuliki.

Figure 2: Drying of fish caught from Lake Albert at Kibiro geothermal prospect. Application of the geothermal heat can improve the quality, hygiene and production of the dried fish.

4.2. Fish farming

Fish farming and fingering hatchery using geothermal heat is applicable in Panyimur, Kibiro, Buranga and Katwe. These are traditionally fishing areas in Lakes Albert, Edward, George and Kazinga Channel.

4.3. Greenhouses

The areas around Panyimur and Katwe geothermal prospects have high potential to grow cash crops like flowers an others in the green houses. These flowers can be flown through the local airports of Kabale (in Kikuube district) and Kasese to Entebbe international airport to the markets in Europe and Asia countries.

4.4. Salt production

Commercial salt can be extracted from saline soils around Kibiro hot springs and also be extracted from the brines of crater lakes in Katwe geothermal prospects. The salty lakes in Katwe field include Katwe, Munyanyenge, Nyamunuka, Bunyampaka, Omurumuri, Kitagata, Mahiga, Kikorongo and Kasenyi.

In Kibiro salt is produced from Muntere (Fig. 3) and Mwibanda salt gardens that are owned and harvested strictly by ladies who later on transfer ownership to their daughters.

Figure 3: The Muntere salt gardens from which the Kibiro women harvest the salt. The gardens are owned by the ladies who later transfer them to their daughters.

The salt is extracted by women by evaporation (Fig. 4) of the salt solution filtered from salt – soil mixture.

Figure 4: A lady extracting salt at Kibiro geothermal prospect by evaporation to dryness. Note the cones (about 30 cm high) of halite salt made by continuous pouring of precipitated of salt. These columns take about 8 hours to extract using dry fire wood collected from the bush around the rift escarpment.

In Katwe area, salt production is done currently by evaporation of brines by sunlight energy in salt ponds constructed around Lake Katwe (Fig. 5) and Kasenyi. This is a slow process; salt production can be improved by application of geothermal heat from Katwe geothermal prospect.

Figure 5: Salt ponds from which the brine from Crater Lake Katwe is concentrated by evaporation using the sunlight energy forming crusts of salt layers that accumulate on pond bottom over time in the dry season.

4.5. Drying of crops

Most geothermal prospects in Uganda are located in crop and animal farming areas. The application of geothermal heat in drying of cash crops in the four investigated areas are described in the next sections.

4.5.1 Buranga prospect

In this prospect, the geothermal heat can be used to dry cocoa (Fig. 6) and palm oil nuts. The two form the main economic activity and the main income earning cash crops in the Bundibugyo district. The heat may also be transported in well lagged pipe to Kijura, Kabarole district and then be used to cure tea which the main cash crop in the area.

Figure 6: Cocoa tree plants at Rwamabale, near Buranga geothermal field. In the background is the northern tip of Rwenzori mountain.

4.5.2 Panyimur prospect

In this geothermal field area located in Pakwach district, the geothermal heat can be mainly applied in drying cassava, maize and cotton, which are the main cash crops in the area.

4.5.3 Katwe prospect

In this field located in Kasese district, the geothermal heat may be applied in drying cotton, maize and beans. The heat can also be used to dry the cotton seeds from which cooking oil and animal feeds are made by the Reco Industries Limited company. The owners of the company had expressed interest in applying the geothermal waste heat.

4.5.4 Kibiro prospect

In this field located in Hoima district, the geothermal heat can be applied in drying tobacco (Fig. 7), maize, beans and ground nuts grown by the indigenous Banyoro and the Bagungu and Arur people that have migrated into Kigorobya-Buseruka area.

Figure 7: Recently planted tobacco near Kibiro geothermal field.

4.6 Oil pipeline heating

Recently, Uganda has made commercial discovery of an estimated 6.5 billion barrels of oil in Albertine graben, 1.4 billion of which are recoverable. Several companies like China National Offshore Oil Corporation (CNOOC) and Total E&P Uganda (TEPU) have obtained production licenses and are currently drilling production wells. The oil from the oil fields is characteristically thick and require heating during transportation to the refinery and also the crude oil pipeline set to run from Hoima in Uganda to Tanga in Tanzania. Interestingly oil fields are close to geothermal fields in the Albertine graben. It is in plan that the oil pipelines in Albertine region shall benefit from geothermal heat to enable crude oil transportation.

4.7 Pasteurization of milk

Buranga geothermal prospect is located near Kibuku – Rwebishengo area in which there are many Batuku cattle keepers. Similarly, Katwe field is located close to the Basongora cattle keepers. Both tribes carry out dairy farming and produce milk that can pasteurized by geothermal heat processes.

4.8 Tourism and spa

Katwe, Buranga and Kanagorok geothermal prospects are located in the National game Parks of Queen Elizabeth, Semuliki Forest and Kidepo Valley respectively. The waste heat from the planned geothermal power plant turbines may be used to heat the water in the pools before re-injection. The spas shall attract tourists for bathing and other persons interested in balneology and also provide employment to people from the local communities and in turn provide income to the companies owning the power plants. Alternatively, geothermal fluids directly from the hot springs can be used to heat the spas. This can be done in Buranga, Kibiro, Ihimbo, Rubaare, Karungu, Kitagata-Marembo, Amuru and Kanagorok.

5. CONCLUSIONS

- The geothermal heat from the potential production fields have an extended direct use applications.
- Agriculture is the back bone of Uganda's economy; coffee is the number one export of Uganda. The application of geothermal heat in drying and processing of agricultural produce shall definitely improve on their quality and production and hence income of the communities surrounding the geothermal prospects.
- The direct use of geothermal heat to cure tea shall protect the environment by reduction or stopping the cutting of trees that are currently cut and used to generate heat for this activity.

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